

DOCUMENT RESUME

ED 231 787

SP 022 647

AUTHOR Nussbaum, Claire A.; Smith-Lawrence, Paula
TITLE Computer Assisted Integration of Preservice Teacher Education Through Interpretive Structural Modeling (ISM).
PUB DATE 12 Apr 83
NOTE 18p.; Paper presented at the National Meeting of the American Educational Research Association (Montreal, Canada, April 11-15, 1983).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Oriented Programs; Education Courses; Elementary School Teachers; Higher Education; *Practicums; Preservice Teacher Education; Problem Solving; *Teacher Education Curriculum; *Vertical Organization
IDENTIFIERS *Interpretive Structural Modeling

ABSTRACT

An application of Interpretive Structural Modeling (ISM), a computer-aided method used to assist groups in studying and analyzing complex problems, was used to develop a hierarchy of various components taught in the Teacher and Practicum Elementary (TAPE) program, a 24-semester hour undergraduate teacher training option. The ISM process breaks down TAPE course subjects into units, places them in hierarchical order on a grid, and compares corresponding items for contribution to each other. Eventually, a hierarchy relating all components to each other is generated. The ISM has several advantages: (1) It enables an instructional team to generate a preliminary hierarchy of components with a minimum of time involvement; (2) The computer logic involved often sheds light on the interrelationships of components, within an instructional system, that are not immediately obvious when groups work together intensively; (3) The product of the program spurs further creative effort and instructional integration with a minimum amount of time involvement; and (4) The hierarchy generated by the program can eliminate duplication of effort and enable planned, deliberate reinforcement of concepts throughout the program of instruction. (JMK)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

COMPUTER ASSISTED INTEGRATION OF PRESERVICE TEACHER EDUCATION
THROUGH INTERPRETIVE STRUCTURAL MODELING (ISM)

ED231787

A paper presented at the
National Meeting of the
American Educational Research Association

on
April 12, 1983
in
Montreal, Canada

By
Claire A. Nussbaum, Ed. D.
University of Texas at El Paso
El Paso, Texas
and the
Region XIX Service Center
and
Paula Smith-Lawrence, Ed. D.
Texas Tech University
Lubbock, Texas

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Claire A. Nussbaum

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☒ This document has been reproduced as
received from the person or organization
originating it.

☐ Minor changes have been made to improve
reproduction quality.

• Points of view or opinions stated in this docu-
ment do not necessarily represent official NIE
position or policy.

SP 022 647

COMPUTER ASSISTED INTEGRATION OF PRESERVICE TEACHER EDUCATION THROUGH
INTERPRETIVE STRUCTURAL MODELING (ISM)

Leslie A. Hart (1983) recently noted that the "brain approach" to learning calls for schools that "provide perhaps ten times as much input as now" and that "promote the detection, extraction, and recognition of patterns" (p. 307). The technological revolution engulfing American society and the explosion of knowledge certainly indicate to educators that the extraction of patterns from confusion must become a primary goal of instruction. But how can pattern extraction skills be imparted to students when teachers often lack these processing behaviors themselves?

TAPE, an acronym for Theory and Practicum--Elementary, is a twenty-four hour undergraduate teacher training option based on the assumption that the integration of theory and practice is vital. One aspect of TAPE involves modeling for preservice teachers interdisciplinary approaches to instruction which emphasize the processes of learning. One long-range goal of the program is development of a management system for the entire twenty-four semester hours of instruction. Production of a scope and sequence is a prerequisite for implementing a management system emphasizing processing skills. Development of a hierarchy of concepts within each subject area taught and relating these concepts in an interdisciplinary manner precedes production of a scope and sequence.

The purpose of this article is to describe an application of Interpretive Structural Modeling (ISM), a computer-aided method used to assist groups in studying and analyzing complex problems, to the development of a hierarchy of the various components taught in the TAPE program. The hierarchy resulting from an application of ISM has resulted in an indepth analysis of the interrelatedness of content areas so that:

1. Repetitions which occur across areas can be deliberate and based upon the need for reinforcement;
2. Unnecessary duplication can be eliminated; and,
3. Integration of content can become a deliberate process modeling, rather than theorizing, for students integration of content and transfer of learning.

The computerized ISM technique permits a systematic curriculum analysis for these purposes. (Burns, 1983).

This article will briefly describe the Interpretive Structural Modeling (ISM) process, the components of the TAPE program, the process used in applying the Interpretive Structural Modeling to analysis of the TAPE program, the hierarchy resulting from the analysis, and changes made in the curriculum as a result of the analysis. While nothing can replace human interaction in the curriculum revision process, the use of ISM can reduce the time required for some of the process and can permit more efficient use of the time allocated to the procedure. Use of computer logic in analyzing curriculum components can often result in an objective view leading to new insights into the processes being taught which might not be obtained with only human interaction.

Interpretive Structural Modeling (ISM)

Interpretive Structural Modeling (ISM) is a computer-aided method designed to assist a group of people in studying and analyzing complex problems. ISM is appropriate as an analysis instrument when the issue or problem under study can be broken down into component parts which describe the situation. Participants in an ISM exercise, as Crim (1979) has noted, "define the structure of a complex system by focusing on the relationships between the elements of the system" (p. 1).

Curriculum revision is often comprised of many factors and involves interrelationships which are difficult to understand. Thus, ISM, which aids a group in focusing on the elements of the problem and contributes to an understanding of the interrelationships in a system, can be a useful tool for curriculum analysis and revision. ISM has been used effectively to help groups discuss and understand a number of different complex societal issues, including environmental issues (Warfield, 1976).

Essentially ISM resembles factor analysis except that concepts are substituted for numerical data; that is, during the ISM process, every element or concept is compared to every other element in the system. Major components of a system must be broken into subunits and the subunits must be broken into smaller elements. The elements of the system must be logically related; that is, one must be able to answer a series of questions regarding the elements, such as: Does Element I contribute to Element II in most cases? In order to apply ISM to a system, the components of the system must be related in such a way that one can answer the above question with one of the following responses:

1. Yes; In most cases Element I contributes to Element II; or,
2. No; In most cases Element I does not contribute to Element II; or,
3. A variation of Number 1 (above) occurs so that Element II contributes to Element I, but not vice versa; or,
4. A variation of Number 1 (above), except the relationship is mutually contributive--Element I contributes to Element II as much as Element II contributes to Element I; or,
5. Mutual exclusion--there is no relationship between Element I and Element II; they are totally independent of one another and have no noticeable influence upon one another.

Since response 3 becomes redundant during the comparison process, only four responses are necessary for purposes of analysis: Yes, No, Both (or mutually contributive), and Neither (or unrelated.)

Once the appropriate responses regarding the status of every component as related to every other component in the system are obtained, the computer generates a hierarchy relating each of the elements in the system to all other components. This hierarchy of components may then become a guideline for modifying curriculum so that duplications of effort are eliminated and reinforcements are deliberately planned rather than occurring in a random pattern.

Thus, ISM uses a computer program, Interpretive Structural Analysis (ISA), as a logical system which automatically rotates grids (or matrices) so that every answer is compared to every other related answer in a rank-order fashion. The system is operated at a keyboard. Once the basic data is fed into the system, the computer asks the appropriate contributive questions. Then, based on the answers fed into the system, ISA compares each new answer to all those already stored in the system. The result is an automatic comparison of all related items. In a logical manner, based on interrelationships shown by rotation of grid comparisons, the computer system will print out a hierarchy based on the answers it receives during the program.

The Program: TAPE--Theory and Practicum--Elementary

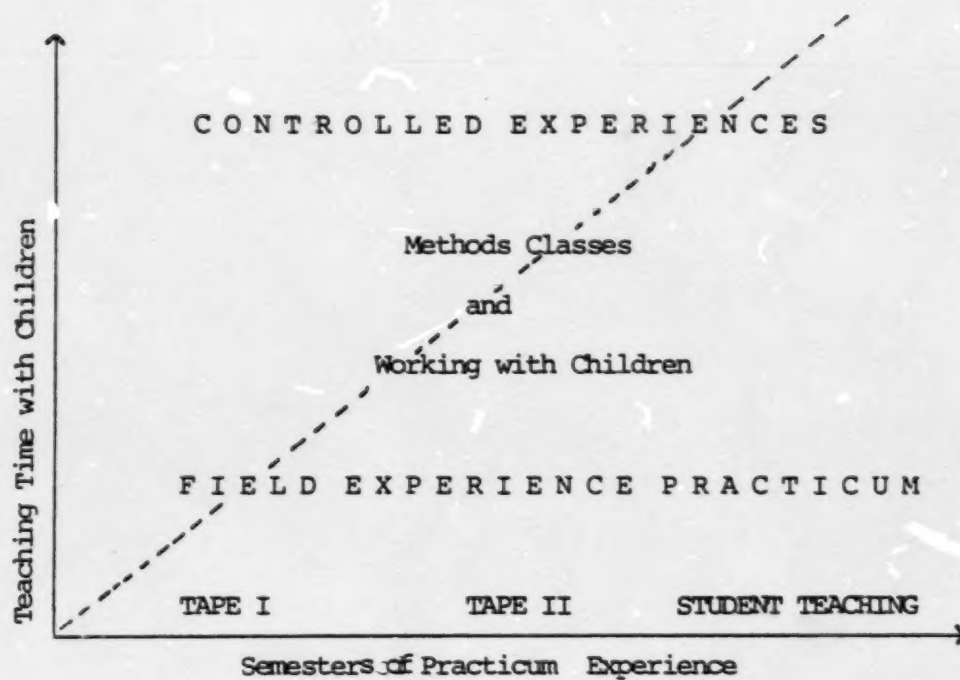
The TAPE program was created by four faculty members who fused their methods courses into a single, twelve-semester-hour methods block. The intent was to provide a field-based alternative to the existing elementary program. The new program was planned to provide opportunities for relevant experience and to improve the pre-student teaching experience. Over a number of years the original program was expanded to twenty-four semester hours

exclusive of student teaching. The first semester, known as TAPE I, includes instructional materials which would traditionally be classified as Educational Psychology, Teaching of Reading, Children's Literature, and Teaching of Science. The second semester, known as TAPE II, includes material equivalent of the traditional courses entitled Teaching of Language Arts, Teaching of Social Studies, Teaching of Mathematics, and The Child and the Curriculum. The final semester is student teaching. Program development has gradually created integration resulting in a format that has caused the courses to lose their separate identities. Separate courses are retained only as an administrative convenience. Because of the change, there is more time to introduce interaction analysis techniques, modified clinical observation cycles, and questioning strategies, all of which are team taught.

TAPE is structured to give preservice students an opportunity to move gradually into teaching and working with children. (See Figure 1.) First experiences are controlled, low-ratio teaching experiences. Low-ratio teaching typically means that two or three elementary school pupils are assigned to each practicum student. During later teaching experiences, students are assigned to work with six to ten pupils. The practicum component of the program provides an introduction to teaching in small groups and adds relevance to the program because TAPE students know that they will be expected to demonstrate and apply "theory" received during the instructional phase of the program. A second dimension of the practicum phase requires students to work one day a week with a classroom teacher in a public school classroom. In the final segment of TAPE this practicum experience expands to three days a week and typically involves whole-group instructional experiences.

FIGURE 1:

Rate of Field Experience Practicum



The goals of the TAPE program have evolved from a relatively structured subject matter orientation to an emphasis on both the process and transfer of learning. This dimension is most evident in the methods instruction component when TAPE faculty members model a process emphasis in their own instructional modes. Instructors also stress the similarity and the commonality of thinking skills of children and adults in subject areas such as Math, Science, Reading, Language Arts, and Social Studies. In addition to this emphasis, the faculty also models sequenced and correlated approaches to instruction. For example, a science lesson that deals with the identification of patterns is scheduled prior to a structured language lesson that uses word patterns in the teaching of reading.

In order to provide the widest possible range of teaching experience, each section of TAPE is assigned to two elementary schools that reflect different cultural and socio-economic populations. Lesson plans are adjusted to fit the needs of the children at each school. Another type of controlled teaching experience, the continuation lesson, involves the same groups of elementary pupils over a period of two or more days and permits university students to base instruction on diagnosis.

Application of ISM to TAPE

TAPE I was the focus of an application of ISM in this study since it has been in existence for a longer period than TAPE II and its components are more clearly defined. TAPE I consists of units which are the academic equivalent of Children's Literature, Foundations of Reading Instruction, Teaching Science in the Elementary School, and Educational Psychology. Through team and individual effort, each of the subjects covered in TAPE I were broken down into the basic units by which each is taught. These units

were then placed in a tentative hierarchical order based on the various instructors' experiences in teaching them. Thus, a tentative hierarchy of units within each subject was developed. Children's Literature and Reading Instruction were merged into one list. The components for the three remaining subject areas are listed in Figure 2.

Each of these lists was then used to form a grid. For example, the hierarchy for Children's Literature and Foundations of Reading Instruction was itemized vertically while the list for Educational Psychology was listed horizontally across the top of the Children's Literature-Reading Instruction hierarchy. (See Figure 3.)

For each item on a grid, the question was asked: Does item A (from the vertical list) contribute to item B (from the horizontal list) in most cases? As previously noted, the response to this question could be: Yes, No, Both (mutually contributive), or Neither (unrelated.) For example, the first item on the Children's Literature-Reading list is a technique of teaching reading, the Language Experience Approach (LEA). If the Children's Literature-Reading list is placed vertically, LEA would be the first item on the list. If one is comparing the Children's Literature-Reading proposed hierarchy to the tentative Teaching Science hierarchy, the Science list would appear horizontally across the top of the page. The first item in the Science list is Observing. So one would ask the question: Does the Language Experience Approach (LEA) contribute to Observing in most cases? The responses could be any one of the following:

1. Yes; The LEA procedure does contribute to Observing in most cases; or,
2. No; The LEA procedure does not contribute to Observing in most cases; or,
3. Both; Observing contributes to the LEA process but an LEA would also contribute to Observing; or,

(Text continued on page 11)

Figure 2:

Tentative Hierarchies of Each Subject AreaScience

1. Observing
2. Inferring
3. Predicting
4. Measuring
5. Using Numbers
6. Classifying
7. Space-Time
8. Communicating

Educational Psychology

1. Developmental Stages of Learner
2. Piaget
3. Transfer Learning
4. Theories of Readiness
5. Gestalt Inductive Learning
6. Grouping
7. Equality of Educational Experience
8. Motivation and Humanistic Psychology
9. Behaviorism
10. Learning Mastery
11. Bell Curve
12. Accountability
13. Performance Contracting
14. Advanced Organizers
15. Individualizing the Environment
16. Special Needs of the Exceptional Learner
17. Controlled VS Open Education

Children's Literature-Reading Instruction

1. Language Experience Approach (LEA)
2. Structured Language
3. Directed Seeing Thinking Activity (DSTA)
4. Directed Listening Thinking Activity (DLTA)
5. Analytic Phonics
6. Skills Grouping
7. Interest Inventory
8. Phonics Test
9. Informal Reading Inventory (IRI)
10. Readiness
11. Management Systems, Reading
12. Norm Referenced and Criterion Referenced Testing
13. Advanced Organizers
14. Directed Reading Thinking Activity (DRTA)
15. Directed Reading Activity (DRA)
16. Individualized Approach
17. Programmed Approach
18. Phonic Approach
19. Basal Approach
20. Linguistic Approach
21. Fernald Approach
22. Study-Reference Skills
23. Critical Reading
24. SQ3R

Figure 3:

Comparison Grid

Respond in each box with: Y = Yes (A contributes to B)
 N = No (A does not contribute to B)
 B = Both (A and B are mutually contributive)
 X = Neither (Unrelated)

Components of the Educational Psychology Tentative Hierarchy
 (This list constituted the "A" Element List.)

(This list constituted the "B" Element list.) Components of the Science Tentative Hierarchy	Observing	Inferring	Predicting	Measuring	Using Numbers	Classifying	Space-Time	Communicating
Developmental Stages of Learner								
Piaget								
Transfer of Learning								
Theories of Readiness								
Gestalt Inductive Learning								
Grouping								
Equality of Educational Experience								
Motivation and Humanistic Psychology								
Behaviorism								
Learning Mastery								
Bell Curve								
Accountability								
Performance Contracting								
Advanced Organizers								
Individualizing the Environment								
Special Needs of the Exceptional Learner								
Controlled VS Open Education								

4. Neither; An LEA would not contribute to Observing and Observing would not contribute to an LEA.

A grid was devised to compare each subject area with each of the other subjects' tentative hierarchies. Each instructor then attempted individually to answer the contributive question with one of the four responses. In this manner each instructor attempted to relate each of the units in his/her instructional area to each of the hierarchical units in all of the other subject areas. Once these replies were tabulated, the data was entered in the ISA program and a hierarchy relating all components in the system to one another was generated. (Burns, 1983).

A TAPE Hierarchy is Generated

Using ISM, the hierarchy in Figure 4 was generated. The Roman Numerals on the left side of the figure represent the level of complexity. Level I is the least complex level, while Level VIII represents the most complex level of the hierarchy. The numbers in parentheses by each term represent the number of the item as it was first entered into the ISA program for Interpretive Structural Modeling.

In some cases several items are enclosed in a rectangle and are labelled as a loop. This means that all items within the rectangle could equally affect one another and are of the same level of importance in the hierarchy.

Each reactangle has an arrow drawn to at least one other rectangle. This indicates that the item or items in the rectangle located higher in the hierarchy affect the item or items in the rectangle located at a lower level. For instance, Inferring, Measuring, Using Numbers, and Classifying (all located in Loop B at Level V), have an effect on Learning Mastery. Since the Learning Mastery arrow points to Behaviorism, Inferring, Measuring, Using Numbers, and Classifying also have an effect on Behaviorism. Behaviorism, in turn,

(text continued on Page 13)

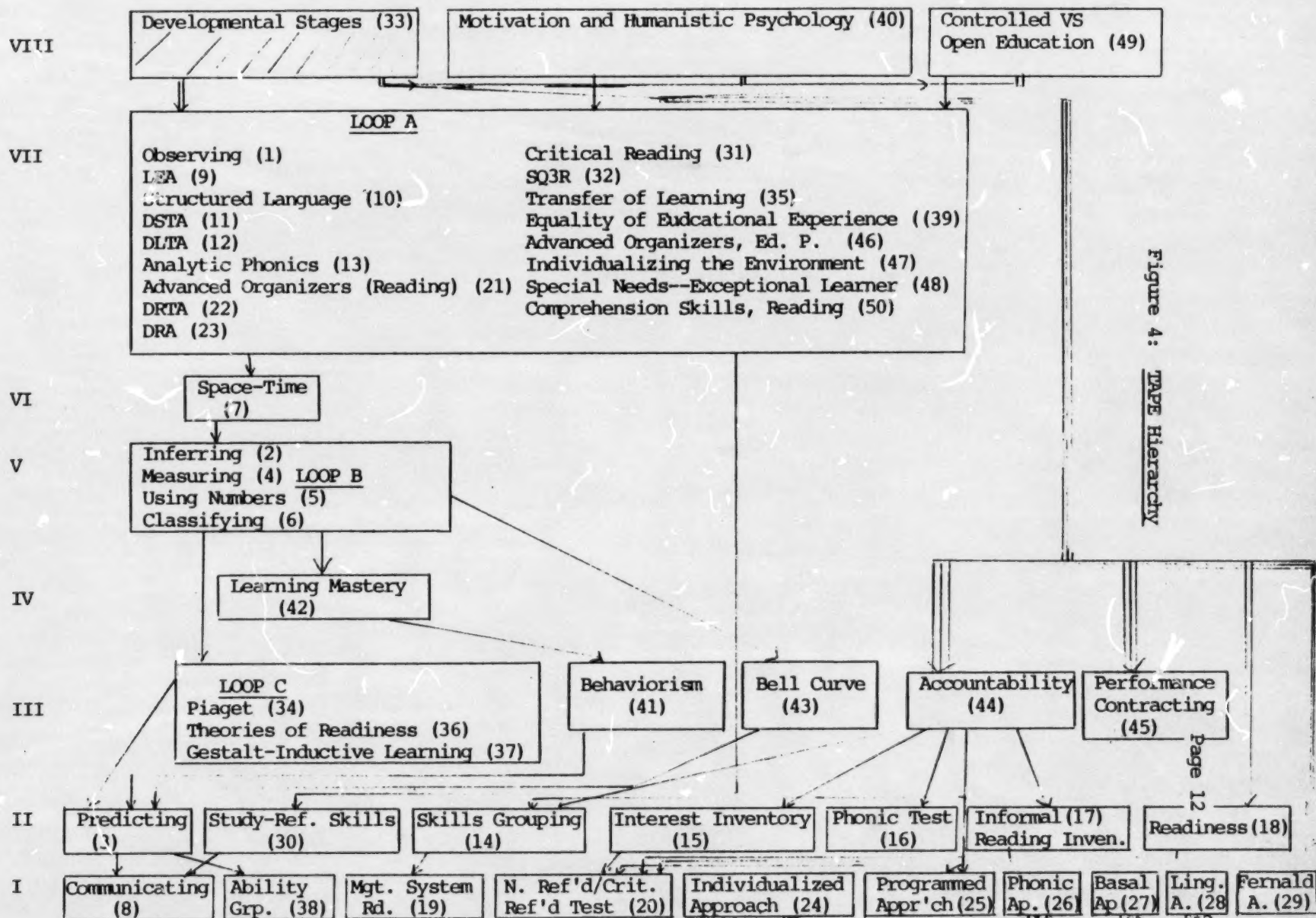


Figure 4: TAPE Hierarchy

influences Predicting, which influences both Communicating and Ability Grouping. Thus all the items in Loop B indirectly influence or have some relationship to the teaching of Communicating and Ability Grouping.

This is more easily seen by tracing the influence of Motivation and Humanistic Psychology throughout the hierarchy. Motivation and Humanistic Psychology (the teaching of a set of concepts about motivation and humanistic psychology) influences almost every other aspect of the system because it not only feeds into the main loop, Loop A, but it also contributes even to those other items which are not linked to Loop A directly. (An attempt was made to show this relationship more clearly by using different types of lines to code the arrows from the three items in Level VIII.)

Impact of the Hierarchy Generated on the Program

Some of the results of the hierarchy developed for TAPE I were not anticipated. It may be that techniques lend themselves well to this particular type of process, while approaches or types of diagnosis do not fit the pattern quite as well. When an attempt is made to incorporate both material from TAPE I and TAPE II into the next hierarchy, some units of particular subjects will be considered as though they are "free floating," rather than as a structural part of the hierarchy. For instance, Reading Management Systems and Norm Referenced and Criterion Referenced Testing or the various approaches to reading instruction (Individualized, Programmed, Phonic, Basal, Linguistic, and Fernald) may be organizational and supportive devices rather than actual components of the hierarchy. Further, for purposes of more preciseness, future ISM analyses might seek to break down the units labelled Special Needs of the Exceptional Learner to a less broad category as well as the item labelled Controlled Versus Open Education. These terms

seemed to be somewhat ambiguous in the process of ISM. Advanced Organizers also reflected some ambiguity as the category was listed in both the Children's Literature-Reading list and in the Educational Psychology list. A future analysis might prefer to label Advanced Organizers in some more differential manner for the two subject areas.

The Potential of ISM in Curriculum Revision and Program Development

ISM may become a powerful tool in the development of a scope and sequence during curriculum revision and program development. As a tool it has the following advantages:

1. It enables an instructional team to generate a preliminary hierarchy of components with a minimum of time involvement;
2. The computer logic involved often sheds light on the interrelationships of components within an instructional system that are not immediately obvious when groups work together intensively;
3. The product of the program spurs further creative effort and instructional integration with a minimum amount of time involvement;
4. The hierarchy generated by the program can—
 - a. Eliminate duplication of effort; and,
 - b. Enable planned, deliberate reinforcement of concepts throughout the program of instruction.

A final advantage of the ISM process is that it may be used as a means of integrating group thinking and may act as an aid in more rapidly attaining group consensus on the methods and content to be taught in a team teaching situation because individual instructor's responses may be entered into the program and the resulting hierarchy may then be used as a focal point for further discussion and program modification.

REFERENCES AND NOTES

Burns, Jim. (1983) Those interested in using the Interpretive Structural Modeling (ISM) computer program described in this article should contact: Dr. Jim Burns, Associate Professor
Business Administration/Information Systems
612 Business Administration
Texas Tech University
Lubbock, Texas 79409
Phone: (806)-742-2176.

Crim, K. O. Using Interpretive Structural Modeling in Senior High School Environmental Studies. University of Dayton Research Institute, Dayton, Ohio 45469, 1979, pages 1-15. (Office of Environmental Education, Dept. of H.E.W., Under Grant No. G0J7700611.)

Hart, L. A. Three Cheers for Smaller Failures? Phi Delta Kappan (Vol. 64, No. 5, Jan. 1983), pp. 303-307.

Nussbaum, C. A. Progress Report on the Scope and Sequence for Field Based Elementary Teacher Education, Texas Tech Univ., Lubbock, Texas. (Nussbaum's current address is: 6770 Edgemere #S17, El Paso, Texas 79925; Phone: (915)-594-7521 or 755-3813; currently with UTEP & Region XIX.)

Smith-Lawrence (Lisman), P. (with Crowder, A., Welton, D. and Simmons, B.) TAPE: An Innovative Field Based Program. Report to TEA, 1982. College of Education, Texas Tech University, Lubbock, Texas 79409. (Dr. Lisman's current address is: Dr. Paula Lisman, College of Education, P.O. Box 4560, Texas Tech Univ., Lubbock, Texas 79409; Phone: (806)-742-2342.)

Warfield, J. N. Societal Systems: Planning, Policy, and Complexity. New York: Wiley-Interscience, 1976. Pages 345-366 and 435-455 are most pertinent to ISM.

NOTE: Although not confirmed at this time, interested persons might want to check very recent literature. The Richardson Independent School District (near Dallas, Texas) has reportedly made use of ISM for curricula development within the district.